**T04D06 – Intermolecular Forces Design Lab**

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Evaporation and Intermolecular Attractions**

**Purpose** Investigate the relationship of dispersion forces and hydrogen bonding forces in intermolecular attractions. **Discussion** In this experiment, temperature probes covered with filter paper are placed in various liquids. Evaporation occurs when the probe is removed from the liquid's container (see figure 1). This evaporation is an **endothermic** process that results in a temperature **decrease**. The magnitude of a temperature decrease is, like viscosity and boiling temperature, related to the strength of intermolecular forces of attraction. In this experiment, you will study temperature changes caused by the evaporation of several liquids and relate the temperature changes to the strength of intermolecular forces of attraction. The temperature change is greater if more evaporation occurs (weaker intermolecular forces). You will use the results to predict, and then measure, the temperature change for several other liquids. You will encounter two types of organic compounds in this experiment — alkanes and alcohols. The two alkanes are pentane, C5H12, and hexane, C6H14. In addition to carbon and hydrogen atoms, alcohols also contain the -OH functional group. Methanol, CH3OH, and ethanol, C2H5OH, are two of the alcohols that we will use in this experiment. You will examine the molecular structure of alkanes and alcohols for the presence and relative strength of two intermolecular forces—hydrogen bonding and dispersion forces. Dispersion forces exist between any two molecules and generally increase as the molecular weight of the molecule increases. A hydrogen bond can occur when, in one molecule, a hydrogen atom is **bonded directly to an N, O, or F atom** (the donor) and that hydrogen is attracted to a **lone pair** on an N, O, or F atom in another molecule (the acceptor). Both a donor and an acceptor must be present for a hydrogen bond to occur.

Develop an experiment that will allow you to determine the relative intermolecular forces between said molecules. This is a design lab so you should have the following:

* Variables (Independent, dependant, control)
  + If you have control variables they must actually be controlled and you must state how they are controlled
* Hypothesis or question
* Literature values (and the sources)
* Diagrams or Aparatus of set up
* List of materials needed
* Detailed Procedures
* Explanation of how data should be collected and organized

**The following chemicals may be used:**

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| --- |
| methanol, CH3OH |
| ethanol, C2H5OH |
| 1-propanol, C3H7OH |
| 1-butanol, C4H9OH |
| heptane, C7H16 |
| hexane, C6H14 |
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**Us e the following questions to help guide your thoughts. If this were not a design lab these questions might have been asked afterwards.**

1. What are the possible types of intermolecular forces? What is strongest, what is weakest? Draw a brief diagram for each.

2. Discover what the ΔT “tells” you about how readily a sample evaporates. Circle the appropriate response to each statement below.

Large ΔT values mean that the sample does does not evaporate readily. Small ΔT values mean that the sample does does not evaporate readily.

3. Correlate your answers to how readily a sample evaporates to the strength of the intermolecular forces in that molecule. (again, circle the appropriate response to complete the statement.)

If the sample evaporates readily, then the relative strength of the IMFs in the molecule is: (circle one) strong weak. If the sample does not evaporate, then the relative strength of the IMFs in the molecule is: (circle one) strong weak.

4. Looking at the formulas for your alkanes, what is the only difference between formulas?

5. What IMF(s) are present in the alkanes (list all present)?

6. Looking at the formulas for your alcohols, what is the only difference between the formulas?

7. What IMF(s) are present in the alcohols (list all present)?